

CLAIMS

What is claimed is:

1. A power transmission device comprising:
 - an input member adapted to receive drive torque from a power source;
 - an output member adapted to transmit drive torque to an output device;
 - a transfer clutch operably disposed between said input member and said output member;
 - a clutch operator operable for engaging said transfer clutch to transfer drive torque from said input member to said output member, said clutch operator including a drive member with a tapered drive surface, and a reaction member having a tapered reaction surface engaging said transfer clutch; and
 - a power-operated actuator controlling translational movement of said drive member for causing corresponding movement of said reaction member due to sliding engagement of said reaction surface with said drive surface so as to vary a clutch engagement exerted by said apply surface on said transfer clutch.

2. The power transmission device of Claim 1 wherein said power-operated actuator includes an electric motor having a rotary shaft, and a gearset interconnecting said motor shaft to said drive member, whereby rotation of said motor shaft in a first direction causes non-rotary translation of said drive member in a first direction and rotation of said motor shaft in a second direction causes non-rotary translation of said drive member in a second direction, and wherein movement of said drive member in its first direction causes said reaction member to move in a first direction toward said transfer clutch for increasing the magnitude of said clutch engagement force and movement of said drive member in its second direction causes movement of said reaction member in a second direction away from said transfer clutch for decreasing the magnitude of said clutch engagement force.

3. The power transmission device of Claim 2 wherein said input member is a shaft with said reaction member journalled on said shaft, and wherein said drive member has a tang segment disposed on one side of said shaft with said drive surface formed thereon.

4. The power transmission device of Claim 3 further comprising a second reaction member journalled and axially restrained on said shaft and having a second reaction surface engageable with a second drive surface formed on said tang segment of said drive member.

5. The power transmission device of Claim 1 wherein said drive member is linearly moveable between a retracted position and an extended position in response to activation of said power-operated actuator for causing corresponding sliding movement of said reaction member between a released position and a locked position relative to said transfer clutch and wherein said reaction member exerts a minimum clutch engagement force on said transfer clutch when located in its released position and a maximum clutch engagement force on said transfer clutch when located in its locked position.

6. The power transmission device of Claim 1 wherein said input member provides drive torque to a primary driveline of a motor vehicle, wherein said output member is coupled to a secondary driveline of the motor vehicle, and wherein said transfer clutch is operable to transfer drive torque from the first driveline to the second driveline.

7. The power transmission device of Claim 6 defining a transfer case wherein said input member is a first shaft driving the primary driveline, said output member is a second shaft coupled to the secondary driveline, and wherein location of said drive member in a first position releases engagement of said transfer clutch so as to define a two-wheel drive mode, and location of said drive member in a second position fully engages said transfer clutch so as to define a part-time four-wheel drive mode, and further including a controller operable to control activation of said actuator for varying the position of said drive member between its first and second positions to controllably vary the drive torque transferred from said first shaft to said second shaft so as to define an on-demand four-wheel drive mode.

8. The power transmission device of Claim 7 further comprising sensors to detect a vehicle operating condition, said controller receiving input signals from said sensors and generating an electric control signal based on said input signals which is supplied to said actuator for controlling the direction and amount of translational movement of said drive member.

9. The power transmission device of Claim 5 defining a power take-off unit wherein said input member provides drive torque to a primary differential associated with a primary driveline of a motor vehicle, and wherein said output member is coupled to a secondary differential associated with a secondary driveline.

10. The power transmission device of Claim 1 defining a drive axle assembly wherein said input member is a drive shaft driven by a powertrain of a motor vehicle, said output member is a pinion shaft driving a differential associated with said drive axle assembly, and wherein said transfer clutch is disposed between said drive shaft and said pinion shaft.

11. The power transmission device of Claim 1 defining a power take-off unit wherein said input member includes a first differential supplying drive torque to a pair of first wheels in a motor vehicle, and a transfer shaft driven by said differential, said output member includes a drive shaft coupled to a second differential interconnecting a pair of second wheels in the motor vehicle, and wherein said transfer clutch is disposed between said transfer shaft and said drive shaft.

12. The power transmission device of Claim 1 wherein said input member includes a first shaft supplying drive torque to a second shaft which is coupled to a first differential for driving a pair of first wheels in a motor vehicle, wherein said output member is a third shaft driving a second differential interconnecting a pair of second wheels of the motor vehicle, and wherein said transfer clutch is operably disposed between said first and third shafts.

13. The power transmission device of Claim 1 defining a full-time transfer case including an interaxle differential driven by said input member and having a first output driving a first driveline in a motor vehicle and a second output driving a second driveline in the motor vehicle, and wherein said transfer clutch is operably disposed between said first and second outputs of said interaxle differential.

14. The power transmission device of Claim 1 defining a drive axle assembly having a pinion shaft driven by said input member and a gearset connecting a transfer shaft to said pinion shaft, and further including first and second transfer clutches disposed between said transfer shaft and corresponding first and second axleshafts.

15. A power transmission device comprising:

a rotary input member adapted to receive drive torque from a power source;

a rotary output member adapted to provide drive torque to an output device;

a torque transfer mechanism operable for transferring drive torque from said input member to said output member, said torque transfer mechanism including a transfer clutch operably disposed between said input member and said output member and a clutch actuator for applying a clutch engagement force to said transfer clutch, said clutch actuator including a drive member having a tapered drive surface, a reaction member having a tapered reaction surface engaging said tapered drive surface and an apply surface engageable with said transfer clutch, an electric motor having a rotary output, and a conversion mechanism for converting rotary motion of said motor output into translational motion of said drive member; and

a control system for controlling the direction and amount of rotation of said motor output for controlling the direction and amount of translational movement of said drive member, wherein translational movement of said drive member causes said tapered drive surface to slide relative to said reaction surface on said reaction member for forcibly moving said reaction member relative to said transfer clutch so as to vary the clutch engagement force exerted by said apply surface on said transfer clutch.

16. The power transmission device of Claim 15 wherein said drive member is linearly moveable between a retracted position and an extended position in response to activation of said electric motor for causing corresponding sliding movement of said reaction member between a released position and a locked position relative to said transfer clutch, and wherein said reaction member exerts a minimum clutch engagement force on said transfer clutch when located in its released position and a maximum clutch engagement force on said transfer clutch when located in its locked position.

17. The power transmission device of Claim 16 defining a transfer case wherein said input member is a first shaft driving a first driveline of a motor vehicle and said output member is a second shaft coupled to a secondary driveline, and wherein location of said drive member in its retracted position releases engagement of said transfer clutch so as to define a two-wheel drive mode and location of said drive member in its extended position fully engages said transfer clutch so as to define a part-time four-wheel drive mode, said control system is operable to control activation of said electric motor for varying the position of said drive member between its retracted and extended positions for controllably varying the drive torque transferred from said first shaft to said second shaft so as to define an on-demand four-wheel drive mode.

18. The power transmission device of Claim 16 wherein said input member is a drive shaft driven by a drivetrain of a motor vehicle, wherein said output member is a pinion shaft driving a differential associated with an axle assembly of the motor vehicle, and wherein said transfer clutch is disposed between said drive shaft and said pinion shaft for transferring drive torque from said drive shaft to said pinion shaft.

19. The power transmission device of Claim 16 wherein said input member includes a first differential supplying drive torque to a pair of first wheels in a motor vehicle and a transfer shaft driven by said first differential, wherein said output member includes a drive shaft coupled to a second differential interconnecting a pair of second wheels in the motor vehicle, and wherein said transfer clutch is disposed between said transfer shaft and said drive shaft.

20. The power transmission device of Claim 16 wherein said input member includes a first shaft supplying drive torque to a second shaft which is coupled to a first differential for driving a pair of first wheels in a motor vehicle, wherein said output member is a third shaft driving a second differential interconnecting a pair of second wheels of the motor vehicle, and wherein said transfer clutch is operably disposed between said first and third shafts.

21. The power transmission device of Claim 16 further including an interaxle differential driven by said input member and having a first output driving a first driveline in a motor vehicle and a second output driving a second driveline in the motor vehicle, and wherein said transfer clutch is operably disposed between said first and second outputs of said interaxle differential.

22. The power transmission device of Claim 15 wherein said tapered drive surface defines a first cam track and said tapered reaction surface defines a second cam track, and wherein said first and second cam tracks are aligned and having rollers disposed therein.

23. A power transfer assembly for use in a four-wheel drive vehicle having a powertrain and first and second drivelines, comprising:

- a first shaft driven by the powertrain and adapted for connection to the first driveline;

- a second shaft adapted for connection to the second driveline;

- a transfer clutch operably disposed between said first shaft and said second shaft;

- a clutch operator for generating and applying a clutch engagement force to said transfer clutch, said clutch operator including a drive member having a tapered drive surface, a reaction member having a tapered reaction surface engaging said tapered drive surface and an apply surface engaging said transfer clutch; and

- a power-operated actuator for causing linear non-rotary translation of said drive member between a retracted position and an extended position, said drive member is operable in its retracted position to locate said reaction member in a released position relative to said transfer clutch and is further operable in its extended position to locate said reaction member in a locked position relative to said transfer clutch.

24. The power transfer assembly of Claim 23 wherein said drive member is linearly moveable between its retracted and extended positions in response to activation of an electric motor for causing corresponding sliding movement of said reaction member between its released and locked positions relative to said transfer clutch, said reaction member exerts a minimum clutch engagement force on said transfer clutch when located in its released position and a maximum clutch engagement force on said transfer clutch when located in its locked position.

25. The power transfer assembly of Claim 23 wherein said first shaft is a first output shaft driving the first driveline, said second shaft is a second output shaft coupled to the second driveline, and wherein location of said drive member in its retracted position releases engagement of said transfer clutch so as to define a two-wheel drive mode, and location of said drive member in its extended position fully engages said transfer clutch so as to define a part-time four-wheel drive mode, and wherein a controller is operable to cause said actuator to vary the position of said drive member between its retracted and extended positions for varying the drive torque transferred from said first output shaft to said second output shaft so as to define an on-demand four-wheel drive mode.